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THE COVER

The crews of our vessels are sailors in the best meaning of that word. Together with some fishermen and the yachtsmen they are among the few who represent and carry on the proud sailing ship history of our country.

The work on board our small lightly manned ships often is hard, the voyages long, the days in port short, few, and far apart. Probably our research vessels are the smallest ships that regularly sail the deep ocean. The cruises can be pleasant when the weather is fine, when the work goes well, and when valuable instruments are not lost. However, fatigue caused by cramped quarters, crowded deck space, and always present wave motion limits the pleasures.

Often we have seen merchant vessels of the "small" type pass by with but the slightest, stately, pitching motion while we on board ATLANTIS or CARYN were receiving a good boneshaking and had to "keep one hand for the ship and one for ourselves."

Unfortunately, sail is not used as often as it was in the pre-war years when oceanography was calmer and more "gentlemanly". Modern oceanography demands frequent course changes or straight line sailing so that the diesels have become primary rather than auxiliary power. The sails, nevertheless, are useful to steady ship or to heave to, while on several occasions they have brought the ships safely to port. ATLANTIS once lost her propeller off the Cape Verde Islands and against many odds returned in time to allow scientists and crew to celebrate Christmas at home.

EDITORIAL

This will be an important year in the history of our Institution. In June the Office of Naval Research's "Laboratory of Oceanography" will be dedicated and will give us much needed "elbowroom". (see page 2). Little did the modest founders of the Institution realize that their plans were so well laid that oceanography's expansion would require almost a doubling of the available space within twenty years.

Some time during the year ATLANTIS will sail on cruise #300. Three hundred cruises during which almost two million miles of ocean were traversed is a record without parallel in the history of oceanographic vessels here and abroad. Although the event is not likely to take place until autumn when Woods Hole's population has decreased to winter size, we hope that a suitable ceremony will be possible.

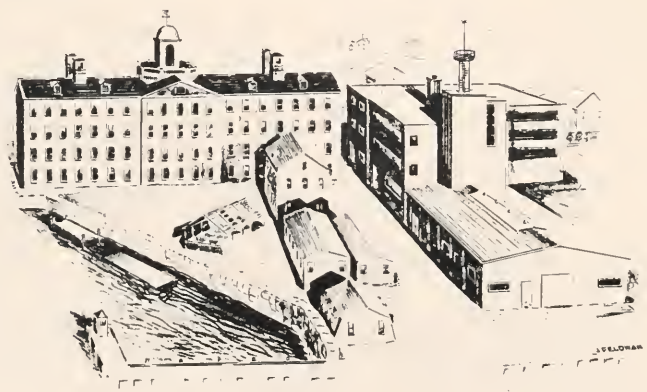
The main article in this issue is devoted to marine biology. New light is thrown on the distribution of large animals in the sea through game fish investigations made by Frank J. Mather III, sport fisherman and biologist. A forecast is made for the possible development of important recreational and commerical game fishing in the Atlantic Ocean.

NEW BUILDING

Great plans are under way for the dedication and convocation of the new LABORATORY OF OCEANOGRAPHY of the Office of Naval Research which has been erected adjacent to our Institution. The dedication will take place on June 21st and it is hoped that many noted civilian and military persons will be present. The Chief of Naval Research will announce the names of the principal speakers in the near future.

The plans are to have an official opening, followed by three days of informal scientific discussions. Many American and foreign scientists will be invited to take part in the discussions. Popular lectures will be arranged for the evening hours.

Although the building is owned by the U. S. Navy it will be staffed and operated by civilian personnel of our Institution. This will relieve the overcrowded conditions in the present laboratory which came about through the great expansion that took place during and since the war years. The "old" building will largely be taken over by nonclassified research programs and it is hoped that marine biological and chemical investigations will expand to keep pace with the advances made in other oceanographic subjects.



School of small tuna swimming just below the surface

THE SWIFT AND THE ROVING

Except for the distant spout of a whale and the occasional flights of flying fishes, few if any other signs of marine life are observed from a ship crossing the Atlantic Ocean. It was generally believed that the open Atlantic is a desert of life, until Frank J. Mather III, biologist on our staff and a sport fisherman of no mean repute, started to troll fishing lines from our research vessels. The results have been astonishing. They show that the "desert of life" theory is open to question, to state it mildly.

During three years of part-time fishing on the open sea Mr. Mather, other scientists and crew members of our ships, captured a total of 225 game fishes such as tuna, blue and white marlin, mackerel-like fishes, dolphins, amberjacks, and barracuda. Some rare and little-known fishes such as the snake mackerel were

also caught. In addition they lost one hundred or more fish and obtained sight records of over 3,000 large animals. In size the catches ranged from an eight foot two inch blue marlin to an 11-1/2 inch bluefin tuna. Though a sport fisherman might have thrown that little fellow overboard in disgust, to Mather the catch was both interesting and important since fewer than a dozen bluefin of that size were known to have been caught in the western North Atlantic. Since then Mather caught five more. Actually these fishes, judged to be the young of the year, must be extremely numerous.

The smallest catches that were made consisted of a 1/4 inch swordfish and several skipjacks about 1/8 inch long. These were taken by towing a silk plankton net at the surface of the sea in an effort to find the spawning areas of oceanic fishes.

Although the number of fishes caught may appear small, it must be borne in mind that the work is being done entirely as a part-time voluntary activity. Regular shipboard duties prevail and at no time can the course of the ship be changed from its primary mission.

This can be most frustrating to an ardent fisherman. After two years, Mather still winces as he recalls the capture within 75 minutes of five blackfin tuna, two false albacore and a wahoo while the ATLANTIS crossed an uncharted shoal off Brazil. "If we could only have stayed there for a whole day," he sighed. Another time off Fernando Noronha, a small island off the coast of Brazil, thousands of birds were seen circling over large wildly turbulent patches of water indicating the presence of game fish. The ship's course could not be changed and passed within a mile of these promising fishing areas.

The fishing was not always successful; "the big ones got away". Occasionally the heaviest lines were broken and large hooks were straightened out. Once a heavy coiled spring, two inches in diameter, which was used as a shock absorber, was stretched out straight into a ten foot piece of wire! Oceanographic instruments were often attacked by unknown assailants. A metal, 35 pound, instrument was almost bitten in two while others showed evidence on their recording apparatus of having hit large objects while being lowered. Further evidence of the existence of large forms of life has come from high-speed plankton samplers. These instruments, consisting of hollow brass tubes, are towed at high speed below the surface. Not infrequently the samplers contain a neat "core" cut from an unhappy and unidentified fish.

Encouraged by the number of fish caught and their wide distribution, Mr. Mather is planning a more extensive program for the investigation of game fish. He has no doubt that this will become possible since during comparatively recent years the pursuit of these fishes has become more and more important. Thousands of persons take to sea on week-ends for recreation on party fishing boats, directly and indirectly they support other thousands, while a commercial fishery utilizing some of the most expensive and most specialized fishing vessels in the world is based on game fish.

Studies must be made not only for their purely scientific value, to obtain knowledge of "the world we live in", but also to place fishing on a scientific basis in order properly to utilize this important resource and to settle on a rational

rather than on a emotional basis any conflicts that may come about between sports and commercial interests.

MANY QUESTIONS

As is true for many other fisheries, virtually nothing is known about the life cycle of game fishes. Swordfish are caught during the summer months off New England. Where do they go during the rest of the year? Where do the game fish spawn? Where do they migrate to? How old do they get and how old are they at a certain size? What are their enemies and diseases? Only fragmentary evidence is available about some of these questions. The oceanic nature of game fish and the fact that they are influenced by physical and chemical changes in sea water and by meteorological conditions make such an investigation a suitable one for this Institution.

While the Pacific supports a gigantic tuna fishery, the open waters of the Atlantic are untouched. It may be possible that organized research would find new food resources at a time when the northwestern Atlantic fishing industry is desperately seeking a new stimulus.

From the biological point of view, a fortunate condition exists in the Atlantic Ocean as no organized fishery exists and there still is time to study an untouched stock. The tunas of the Pacific and off western Europe have received much scientific attention but only after the stock had been heavily fished. Most fishery biologists bewail the fact that their studies receive support only once a stock is showing decline and that they never have a chance to investigate an untouched stock in its natural balance.

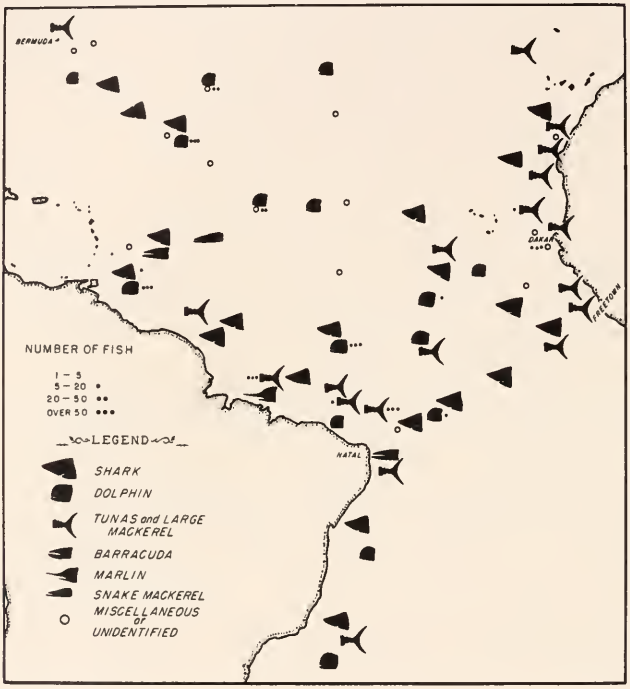
DISTRIBUTION

Mather's enthusiasm and tenacity has laid the groundwork on which a larger program can be based. Certainly it has shown valuable information, considering the limited nature of the work. For instance, much has been learned about the distribution of game fishes. The known northern range of blackfin tuna, falcate and little amberjacks, the little dolphin and other game fishes has been extended. Wahoo, which was known from the Gulf of Mexico and the Caribbean, was caught near the Cape Verde Islands thus enlarging its eastern range by two thousand miles. These findings have resulted in the publication of a number of monographs in a scientific journal.

Since most of our investigations have taken place in the northern hemisphere, virtually nothing is known about the pelagic fishes that inhabit the southern Atlantic. For the same reason nothing is known about the southern limits of the northern species. As far as the density of the distribution is concerned the best catches were made in the Equatorial Current and the Guiana Current. The colder waters of the Canaries Current off West Africa were slightly less productive, nevertheless they yielded good catches of tuna-like fishes. As might be expected the poorest results were obtained in the Sargasso Sea where dolphins were the only interesting fish caught.

Plankton tows made during our Equatorial cruises, in an effort to discover spawning areas, yielded in addition to the miniature swordfish and oceanic bonito already mentioned, many tuna larvae which were tentatively identified as yellowfin or blackfin tuna. The state of our knowledge lies exposed when such relatively insignificant hauls are considered worthy of

mention. It is astonishing to realize that our lack of knowledge concerning the initial stages of game fish makes it appear as if the swift and roving animals of the sea spring up fully grown.



Distribution of pelagic fishes in southern waters

If tuna eggs and larvae follow the fate of the myriads of other fish eggs, so that only one out of thousands survives, then somewhere at some time there must be untold numbers of tuna eggs. Only an extensive search by a vessel sent out for that task or an accidental discovery will ever find such a time and place. One generally does not realize the extent of the ocean nor the limitations of oceanographic research. Plankton tows demand a slow speed of the ship, so that they are only made at certain times and occasions. A further dilemma lies in the fact that since so few eggs and larvae have been found there remains the difficulty of identification.

Frank J. Mather shows result of 75 minutes fishing

BLUEFIN TUNA

When not at sea, Mr. Mather has been busy on a cooperative bluefin investigation with Mr. Howard S. Schuck of the Fish and Wildlife Service. A scientific paper on this work is in preparation. Suffice it to say here that as a result of their labors the growth rates of the fish up to ten years of age can be measured. It is rather astonishing to realize that the larger tuna gain one hundred pounds during the three summer months while the smaller ones gain one inch every month.

Thousands of bluefin weighing from 1-1/2 to 950 pounds were measured and weighed while two hundred were measured in great detail and found to be a race separate from the Pacific and European bluefin. Taxonomic questions have to be settled to differentiate between races of the same species. The different races do

not have the same spawning areas and migration routes so that they should be handled as a separate stock as far as fishing is concerned. Many other data such as information on their food, habits, and sexual maturity were also collected.

As a result of this work some theories were developed regarding the migration routes of bluefin tuna. The fish fall into three groups by size; of these only the largest group are seen passing the Bahamas in spring during the northward trek, although it is not a conclusively proven fact that these are the same fish that are being caught off New England during the summer months. Unsuccessful attempts were made to follow the schools by airplane from the Bahamas and a number of the large fish were tagged with marked hooks in the hope that they would be recovered later during the year.

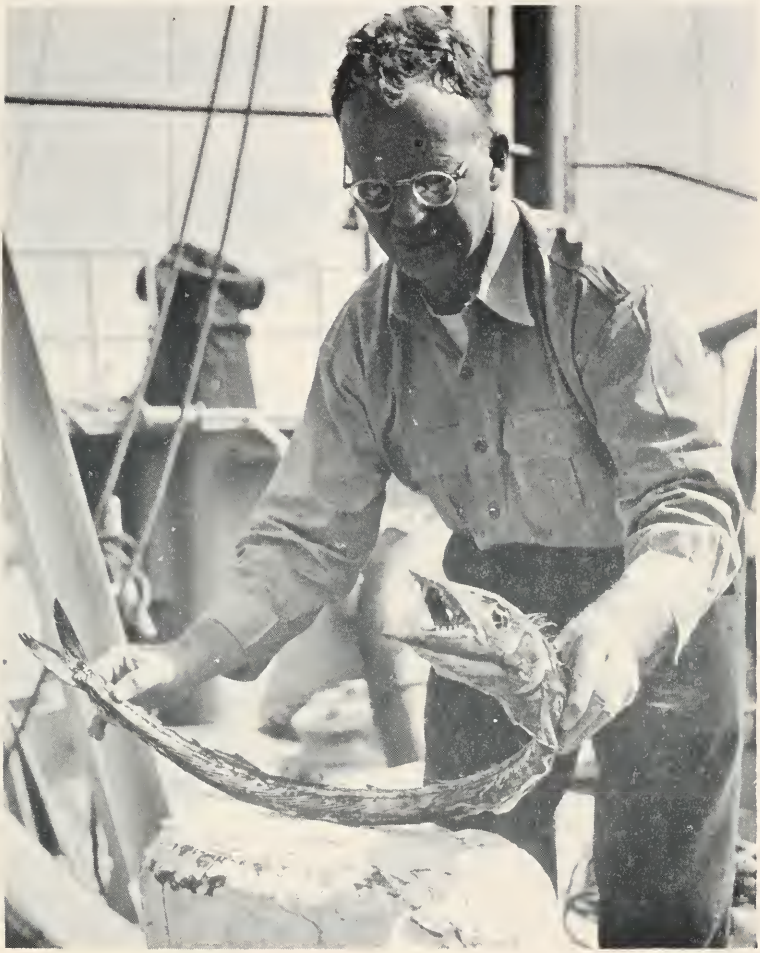
The middle-sized group and the smaller one appear from nowhere off New England during the summer. Since tuna undergo striking seasonal changes in behavior, sometimes swimming at the surface and feeding avidly while at other times swimming deep and hesitant to take bait, it is possible that the smaller groups do not wander far away but remain on their summer grounds at a deeper level.

TAGGING

One way to learn more about such habits is through a program of tagging which has been so useful in the investigation of other migratory fishes. No successful way to mark large tunas has been developed, although recently a method for small fishes has been evolved. It is one thing to tag a cod or haddock and quite another thing to mark a fighting, beating tuna. In western Europe, where distinctive hooks were used by fishermen from different localities, some information was obtained from hooks found in the throat or

A blue marlin taken in the Guiana Current off the coast of Brazil

Yellowfin tuna caught 350 miles southwest of Freetown, West Africa



A three foot snake mackerel was taken about 500 miles east of Barbados

A wahoo, probably the first recorded from the eastern Atlantic

stomach of captured fish which had broken lines during previous encounters. Encouraged by this report Mather and Schuck marked hooks used by sport fishermen who often lose fish involuntarily. Some of the sportsmen even volunteered to release their catch, once the fish had been brought alongside their boat. As mentioned above quite a few tuna were marked in this way but no returns have come in to this date.

More recently Pacific investigators developed a new method for marking small game fishes, which has shown more success than any previous system. The mark consists of a plastic loop attached through the back of the fish just behind the second dorsal. Small game fishes may be brought into a boat and held tight in a wooden trough so that they will not beat themselves to death, marked, and released as quickly as possible. One albacore was recovered in the Pacific after swimming a distance of 4,650 miles in 324 days. Mr. Mather is now planning to use this method to tag several hundred small bluefin during the summer when they usually appear in great numbers off southern New England.

THE FUTURE

Much more must be learned. It is hoped that a larger program will become possible, although the emphasis necessarily would be on tuna--as the most valuable food and game fish--much information on other game fishes would be obtained simultaneously.

Further work must be done on the distribution of game fishes in the Atlantic Ocean and extensive work on the location of spawning grounds and migration routes could be done with the aid of sonic sounding and ranging, and by airplane spotting. Tuna would be located and followed as far as possible by these methods,

preferably to their spawning grounds. For identification purposes a number of fishing techniques would be used, such as surface trolling, deep trolling with depressors, chumming, drifting with deep lines, night fishing by lights, etc.

If contact can be maintained to the spawning area extensive plankton hauls would be made to follow the life history of eggs, larvae, and young. Every bit of information on the biological community, on enemies, diseases, food and water conditions should be obtained at the same time.

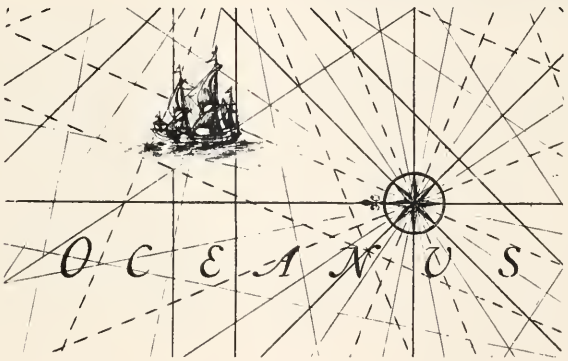
If the fish cannot be followed to the spawning areas, these should be found by extensive plankton hauls covering hundreds of miles of the Caribbean Sea, while tows in other areas, during all seasons, are also desirable.

Identification of the plankton catch will aid in the location of centers of production, to estimate the quantities of newly spawned eggs (and thereby deduce the number of spawners), to trace the drift of larvae, and to obtain a knowledge of their survival from natural conditions.

Physiological study will also be necessary. One investigator has indicated that tuna find their food by smell, just as sharks do. How far they can smell, how far they can see, how they respond to sound, color, and light are other interesting questions whose answers could benefit the angler and commercial fisherman alike. A vital answer may come from an unexpected direction. For instance, in the Pacific Ocean the tuna's reaction to high-frequency vibrations are being investigated. One fishing boat is reported as having been fitted out with a high-frequency vibrator in an effort to attract the fish.

The pursuit of the big game of the sea is an exciting pastime. The fish are there; the scientific and technological knowledge exists to start on a program which would make the catching more rewarding and place it on a suitable basis--relating catch to distribution and abundance.

In comparison, stock breeding on land has been placed on a scientific basis through the efforts of many agricultural stations. If the farmer had no knowledge about the abundance of cattle, its whereabouts during eight months of the year; if he did not know the number of its young, its diseases and enemies; if all these things were true the price of a steak might well be ten dollars a pound which, fortunately, is not yet the case.



"Trade Wind Clouds" is the title of an article in the November 1953 issue of Scientific American. The article was written by Dr. Joanne Malkus, marine meteorologist on our staff. It describes some of the work performed by our meteorologists at Puerto Rico during the spring of 1953, while using the amphibious PBY airplane loaned to the Institution by the U. S. Navy.

'The time has come,' the Walrus said,
'To talk of many ides:
Of clams--and barnacles--and altitudes
Of lizards--and of tides.'

(with apologies to Lewis Carroll)

The word "respect" denoting honor and esteem serves excellently to describe the feeling of anyone meeting our Associate Director and Senior Biologist, Dr. Alfred C. Redfield. A long career in the service of science has made him conversant with a great variety of biological, chemical, and physical aspects which culminated in what is probably his most outstanding ability; being able to absorb a welter of data, sift them, and come directly to the heart of a problem.

This ability probably is responsible for the characteristic preoccupied way in which Dr. Redfield is seen wandering down the halls of the Institution. Rarely using the "inside" telephone system or calling people to his office, he will climb the stairs to state his subject directly and lucidly to the person involved.

The title Senior Biologist is too restricted to describe Dr. Redfield's scientific acumen. A physiologist he is Professor at Harvard where he obtained his doctorate in 1917 on a thesis describing early work on hormones, particularly the role of the adrenalin glands in producing color changes in lizards.

A voluble proponent of pure science, Dr. Redfield has long been associated with Woods Hole. For many summers he worked at the Fisheries Commission and at the Marine Biological Laboratory, in the days before the Oceanographic Institution was even a glimmer of future hope. Teaching research at Harvard's Medical School, he became interested in the ten new radium techniques as a result of a grant made to Harvard by members of the Forbes' family. His experiences in this field will benefit our Institution in the near future since it is planned to install a radio-isotope laboratory for measurements of the basic productivity of the sea.

Although Dr. Redfield gives the impression that he would rather stay at home than be on the move, he is widely travelled and has just returned from a second trip to Venezuela to study the circulation of Lake Maracaibo. As a young man he went to the Cavendish Physical Laboratory at Cambridge, England, and undertook the study of oxygen deficiencies experienced by people living at high altitudes. Subsequently an expedition to Peru was responsible for an important change in his life. While there he became interested in ecology, the relationship between animals and their environment, which led him away from medical research.

In 1930, a sabbatical year, the associate professor at Harvard decided to follow a long-felt urge to study more organic chemistry. Travelling to Munich, Germany, he found out that, "I never learned but got rid of an inferiority complex," as he dryly commented.

At about this time Dr. H. B. Bigelow was scouting for people interested in appointments to the staff of our newly founded institution. Apparently Dr. Bigelow did not need to convince our senior biologist too hard that summers at Woods Hole were never misspent. During the following years Dr. Redfield took part in many cruises of the ATLANTIS while continuing to amass other duties, becoming a full professor at Harvard's Department of Biology and a Trustee of the Marine Biological Laboratory.

In 1940 he came permanently to Woods Hole as Associate Director and headed a large group of scientists investigating the biological fouling of underwater structures and ship's hulls. This work resulted in the publication in book form of "Marine Fouling and Its Prevention", and placed the manufacture of antifouling paints on a scientific basis. At the same time a variety of other problems attracted his attention, such as the buoyancy control in submarines, the wake of surface ships, and others. After the war shellfish investigations and local tides came under his scrutiny, while perhaps his major postwar achievement was the study of pollution in harbors and estuaries. A proponent of clean beaches and better recreational facilities, Dr. Redfield, together with Dr. Bostwick H. Ketchum, attacked the problems with such vigor and novel approach that the results have caused great interest among engineers having to deal with the flushing of harbors and among scientists studying the mixing of superimposed layers of fresh and salt water in such structures.

Dr. and Mrs. Redfield, whose home overlooks Vineyard Sound, are both active leaders in civic affairs and between their labors, still find time to visit their three married children who are spread from Cambridge to Mexico.

How did he start? "As a boy I was interested in birds and wanted to be a naturalist."

A revision of "Fishes of the Gulf of Maine" has just been published as Fishery Bulletin 74 of the Fish and Wildlife Service, U. S. Department of the Interior.

The authors, Dr. H. B. Bigelow and Mr. William C. Schroeder, have worked for years keeping up-to-date files on the contents of the original edition published in 1925.

ASSOCIATES NEWS

The Annual Dinner at the New York Yacht Club was a great success, due to the courtesy of the Edo Foundation which supplied the wherewithall and also the principal speaker, Captain Jacques-Yves Cousteau. More than 175 people were present and listened with rapt attention to Captain Cousteau's interesting accounts of his underwater activities. Striking underwater motion pictures, particularly those showing the salvage of a Grecian ship in the Mediterranean, were shown by our French colleague, whose modesty hides the fact that he is undeniably a brave man.

At the conclusion of the dinner Captain Cousteau presented the Institution with a gracefully shaped Amphora, a Grecian wine vessel, salvaged from a wreck which sank more than 2,000 years ago.

YOUR STAKE IN THE LAST FRONTIER, our brochure aimed at industrial support is off the press and ready for distribution. Mr. Noel B. McLean of New York City, President of the Edo Corporation, has accepted the post of Chairman of the Corporate Associates and is forming a committee to aid him in his tasks.

General Foods Corporation has become the first industrial member of the Associates (see: Gifts and Grants). Following this announcement the Boston Herald stated in an editorial: "We hope that other industries will follow the spirit of General Foods' statement and support research which will increase man's knowledge, for the progress of man depends directly on such pioneer work."

GIFTS AND GRANTS

The largest gift received since the original Rockefeller Foundation endowment came our way when the General Foods Corporation donated their East Boston Marine Base and a check for $15,000. In addition General Foods Corporation became the first Corporate Associate of the Institution.

The East Boston base consists of four wharfs, almost six acres of ground, and a number of buildings. The check and deed to the property were presented to Admiral Smith by Udell C. Young, Vice-President of General Foods.

Mr. Young explained that his company made the gift as a means of supporting oceanographic research. "Since General Foods is a leader in supplying America's homes with frozen seafood," he said, "it is natural that we should be interested in supporting man's efforts to increase his knowledge of the sea and its inhabitants."

One thousand copies of S. Kip Farrington, Jr.'s "Game Fishes of the Pacific" were donated by Mr. John M. Olin, President of Olin Industries and a well-known game fisherman. Both author and donor are members of the Woods Hole Oceanographic Associates. The books may be used in any way the Institution desires. This is not the first time that Mr. Olin has aided science. In 1952 he caught a 504 lb. Mako shark which when opened was found to carry ten young. One of the shark embryo was sent to our shark expert, Mr. Schroeder, who was most happy to receive it, as little was known about the size and number of Mako young in a brood.

Dr. Joanne S. Malkus, marine meteorologist, has received a grant of $5,000 for one year's stay at the Imperial College of Science and Technology in London, England. Dr. Malkus will do research on cloud physics and will have the status of Honorary Lecturer in the Meteorological Department of the Imperial College. The grant was made by the Munitalp Foundation, Inc. Dr. Malkus, who has published many papers in marine meteorology, has made frequent flights with the PBY amphibious plane (on loan to us from the U. S. Navy). Her husband, Dr. Willem V. R. Malkus, is physical oceanographer on our staff.

The National Science Foundation granted a sum of $6,200 to Dr. George L. Clarke, marine biologist on our staff, to support research for one year on the penetration of light into the sea and its effect on aquatic organisms. Dr. Clarke has been on our staff since the opening of the Institution and has made valuable contributions to marine biology. Outstanding among these are his studies on the penetration of light into the sea and on the vertical distribution of plankton.

Dr. Per L. Scholander, physiologist, has received a grant of $8,500 from the National Science Foundation. Dr. Scholander has made important studies of the mechanism of diving in aquatic mammals; the temperature control of arctic and tropical animals; and the secretion of gas in the swim bladder of deep-sea fishes.

CURRENTS AND TIDES

Dr. Bostwick H. Ketchum was recently promoted to Senior Biologist on our staff. Dr. Ketchum represented the Institution at the International Congress of Bacteriologists held at Rome, Italy, last September.

Crown Prince Akihito of Japan visited the Institution on September 20th. A rare deep-sea fish, caught by Mr. Schroeder last year, was presented to the Prince as a gift for the Emperor, whose interest in marine biology is well known.

We are deeply grateful for the miraculous rescue of Dr. Maurice Ewing who was washed overboard from the research vessel VEMA during a gale off Bermuda. Dr. Ewing, an Associate member of our staff, is Director of the Lamont Geophysical Observatory at Columbia University.

"Philanthrophy's Role in Civilization" is the title of a book written by Dr. Arnaud C. Marts, President of our Institution. Published by Harper Bros., the book describes the vital role played by the millions of Americans who contributed and continue to contribute to good causes.

In addition to the scientific staffs at sea or in the air our staff members range far and wide. Drs. Redfield and Ketchum and Mr. Bumpus were in Venezuela during March to study the circulation of Lake Maracaibo. Mr. Metcalf was on board an icebreaker in the Arctic Ocean. Mr. Fuglister and Mr. von Arx are on leave of absence, respectively, at Scripps Institution of Oceanography and at the M.I.T.

Dr. and Mrs. Scholander and Dr. van Dam were at Miami, Florida. Mr. Stommel and his associates have been at the Bermuda Biological Station all winter. This group is using the island as a fixed "anchor station" out in the Atlantic Ocean.